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Research Product 88-02

Training and Lessons Learned Data Requirements from the National Training Center

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Presidio of Monterey Field Unit
Training Research Laboratory

April 1988

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U. S. Army Research Institute for the Behavioral and Social Sciences

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER: ARI Research Product 88-02	2. GOVT ACCESSION NO.: ADA194327
3. RECIPIENT'S CATALOG NUMBER:	
4. TITLE (and Subtitle): TRAINING AND LESSONS LEARNED DATA REQUIREMENTS FROM THE NATIONAL TRAINING CENTER	5. TYPE OF REPORT & PERIOD COVERED: Final Report 1981-1986
	6. PERFORMING ORG. REPORT NUMBER: --
7. AUTHOR(s): Carol A. Johnson (ARI), and Michael J. Shadell (NTC Observation Division, Center for Army Lessons Learned, Combined Arms Training Activity)	8. CONTRACT OR GRANT NUMBER(s): --
9. PERFORMING ORGANIZATION NAME AND ADDRESS: U.S. Army Research Institute Field Unit, P.O. Box 5787, Presidio of Monterey, CA 93944-5011	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 2Q263743A794, 5.1.1.
11. CONTROLLING OFFICE NAME AND ADDRESS: U.S. Army Research Institute for the Behavioral and Social Sciences, 5001 Eisenhower Avenue, Alexandria, VA 22333-5600	12. REPORT DATE: April 1988
	13. NUMBER OF PAGES: 60
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): --	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE: --

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

--

18. SUPPLEMENTARY NOTES

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

National Training Center (NTC)	Combat service support	Direct fire
Data requirements	Intelligence	Indirect fire
Command and control	Mobility	Maneuver
Survivability	Countermobility	
Air defense artillery	Communication	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Specific data requirements for training and lessons learned that would improve the utility of data from the National Training Center are identified. These requirements will be integrated with requirements from Combat Development agencies for the planned system upgrade. Additional technological requirements are also identified.

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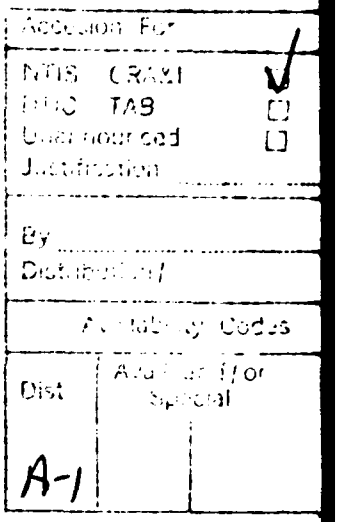
Research Product 88-02



Training and Lessons Learned Data Requirements from the National Training Center

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Department of the Army

April 1988

Army Project Number
2Q263743A794

Education and Training

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FOREWORD

The Army Research Institute (ARI) has a major research program in support of the National Training Center (NTC) sponsored by the Training and Doctrine Command and the Deputy Chief of Staff for Personnel. One of the principal goals of this program is the development of Lessons Learned methodologies for training, doctrine, organization, personnel, and equipment.

The research described in this report was conducted by ARI's Presidio of Monterey Field Unit, whose mission is to increase Army unit combat performance capabilities by improving unit performance measurement and evaluation methods, unit training program and management tools, and the NTC and home station data base.

The Program Task that supports this mission is entitled "Field Feedback from National Training Center to Improve Collective and Individual Training" and is organized under the "Maintain Force Readiness" program area. This research was sponsored by the Combined Arms Training Activity (CATA) under the Letter of Agreement entitled "National Training Center (NTC) and Unit Home-Station Training and Feedback System," dated 16 September 1985. The CATA Lessons Learned Division was briefed in September 1986 on the information in this document, and indicated its intention to use the results. This research identifies specific data requirements that would improve the utility of data from the NTC for training and Lessons Learned. These requirements were integrated with requirements generated by Combat Development agencies. These integrated requirements were then supplied to the Directorate of Army Ranges and Targets, which is responsible for upgrading the NTC instrumentation system. This research has been the subject of a Task Order to determine the feasibility of implementation.

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ACKNOWLEDGMENTS

The authors would like to express their appreciation to all of the Schools and other agencies who reviewed the draft of this report and provided input on their data requirements. They would also like to thank LTC Robert Coon and MAJ John Kenney, CATA; MAJ W. Weaver, DART; and Mr. Ben Covington, Headquarters TRADOC, for synthesizing this input into the final document.

TRAINING AND LESSONS LEARNED DATA REQUIREMENTS FROM THE NATIONAL TRAINING CENTER

EXECUTIVE SUMMARY

Research Requirement:

A statement of work currently solicits proposals to upgrade the National Training Center (NTC) software. The Combined Arms Training Activity (CATA) convened a meeting on July 17-18, 1986, to determine the specific data requirements for training and Lessons Learned that might be incorporated into this solicitation. Following this meeting, personnel from CATA and the Army Research Institute (ARI) continued to refine the data requirements. This report is the result of that process.

Procedure:

ARI presented an overview of its NTC-based research program. Using the results of an earlier meeting (May 13-14, 1986) as a starting point, specific data requirements were generated for improving the data collection system. The goal of the group was the design of a system to assist the NTC Operations Group in conducting training and also provide required Lessons Learned information.

Findings:

Specific data requirements were generated within the general structure of the seven operating systems (Command and Control, Intelligence, Maneuver, Fire Support, Air Defense, Mobility/Countermobility, and Combat Service Support). It was clear that the various NTC data sources must be able to be automatically synchronized. Written documents pertaining to the operation, including graphic control measures, must be automatically entered into the data base. Improved resolution of the computerized contour map is also necessary to do many of the analyses.

Some of the requirements will require additional technology. Examples of such technology are discussed, with particular emphasis on the need for an electronic clipboard to assist the observer/controllers in conducting training and for providing standardized observations for Lessons Learned.

Utilization of Findings:

This report identifies data requirements for training and Lessons Learned and will serve as a basis for integration of data requirements generated by Combat Development agencies. These integrated requirements will be supplied to the Directorate of Army Ranges and Targets, which is responsible for upgrading the planned instrumentation system.

TRAINING AND LESSONS LEARNED DATA REQUIREMENTS FROM THE NATIONAL TRAINING CENTER

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Introduction

Background

The Combined Arms Training Activity (CATA), with the support of the Army Research Institute (ARI), is conducting an on-going effort to improve the quality and utility of data from the National Training Center (NTC) for use in Lessons Learned. The primary purpose of the NTC is training of battalion task forces in a simulated combat environment. However, an additional purpose of the NTC is to serve as a source of data. Trends from multiple engagements across multiple task forces can provide important information for training, doctrine, equipment, and procedures.

The testing community traditionally works in a very controlled environment to provide answers to materiel issues and other relevant questions. By conducting dedicated tests, they are able to gather extremely specific information regarding cause and effect. However, the NTC offers the opportunity to gather data in a much more combat-realistic setting. While the conditions are less controlled, repetitive events over time allow trends to be discerned and there is increased confidence that these trends are relevant to a combat environment. Dedicated tests will still be necessary at other locations, but it is important to take full advantage of the opportunity offered at the NTC for Lessons Learned.

On May 13-14, 1986, an initial working group meeting to discuss methods of improving the quality and utility of NTC data was held. The purpose of this meeting was to share information on current activities and problems and to develop general recommendations for near-term and longer-term approaches to improving NTC data (Johnson, 1986).

Generation of Specific Data Requirements

CATA convened a meeting at the NTC on July 17-18, 1986, to determine the specific data requirements for training and Lessons Learned that might be able to be incorporated into the current request for proposals which solicits proposals to upgrade the NTC software and hardware. Agencies represented at this meeting included:

- NTC Operations Group
- ARI
- TRADOC Analysis Center, Monterey
- Arroyo Center
- Army Training Support Center
- United States Army Infantry Center
- Directorate of Army Ranges and Targets (DART)

In addition, representatives of Combat Development agencies met simultaneously at the NTC to refine their data requirements which were generated in a meeting at Headquarters, U. S. Army Training and Doctrine Command (TRADOC), on July 9-10, 1986. It is the intent of CATA to integrate both sets of data requirements and provide them to DART by October 15, 1986.

ARI presented an overview of their NTC-based research program. Briefing materials are at Appendix A. During the discussion which followed, the participants agreed that there were five major requirements for an upgrade of the current data collection system:

- Greatly improved position location and firing data.

- The integration of all data sources, i.e., automatic statistical display, the digital data tapes, and the communication tapes through time tagging, and all graphics, orders, and scenarios to ensure a clear picture of the on-going battle.

- Insurance that conclusions drawn are valid by comparing force-on-force performance to live fire performance in those situations where it is appropriate. This will require the ability to make live fire firing/target pairings. It would seem that the current method for pairings in force-on-force exercises might also be appropriate for live fire exercises. This method requires that a firing event and effect take place within a specific time period.

- An electronic clipboard to facilitate collection of observer/controller (OC) observations.

- Flexibility of the future system so that software changes can be easily made to accommodate new weapon effectiveness and new weapon systems.

Using the results of the May 13-14 meeting as a starting point, the participants generated more specific data requirements. The focus of the group was the design of a system which would enable the NTC Operations Group to do their training better and easier and which would provide required Lessons Learned information. This will ensure that the historical database can provide answers to future questions so that it will not always be necessary to design individual data collection efforts.

Following the July 17-18 meeting, CATA and ARI personnel continued to refine the training and Lessons Learned data requirements. They reviewed material which had been generated over the previous four years regarding questions which could potentially be answered at the NTC (Johnson, 1986, Appendixes D through G). This report presents the results of that process.

Discussion of Data Requirements

Position Location

There are a few general themes which are prevalent throughout the following data requirements. Clearly, accurate position location for all

weapons systems down to portable antitank systems and units down to squad level is an essential requirement. This includes continuous position location on all OCs. While the planned system upgrade will provide a capability for increasing the number of instrumented players, additional position location hardware is required to exploit this capability.

Also, the degree of resolution of the map available in the computer display is inadequate for desirable tracking. It is important to be able to determine whether line of sight exists between killer and target. Ideally, the system should be able to differentiate to a contour interval of one meter. While this may not be attainable, any improvement in the current twenty meter resolution would be desireable. Improved resolution is important not only for accurate position location and for determining line of sight between engaging systems, but also for masking and unmasking for helicopters and trafficability data for cross country movement.

The system should also display position location with a symbol which clearly identifies the type of vehicle or personnel on a scale commensurate with the scale of the map being used. Currently, the symbols are a single size, regardless of map scale. When a large scale map is being used, the symbols are so large in relation to the map that it can be dysfunctional to the analysis effort.

Position location of all assets also implies the ability to determine a Z coordinate. This includes the altitude of all aviation assets and also the depth of obstacles, survivability, position, etc. Improving the resolution of the map will also improve the accuracy of these data.

Visual Display of Data

The need to display, record and retain all C^3I, METT-T, commands, graphics, and conditions is absolutely essential. Substantial portions of the Army's system of command and control is based on the use of graphic control measures. The measures used for a mission should be able to be visually displayed on the map and captured and permanently recorded by the system.

All operations, intelligence, and fire support maps should be able to be visually displayed to analysts in the Core Instrumentation System (CIS) and retained in the system. This is also true for planning ranges for various types of equipment and the display of location and distribution of impact of weapons effects. Both the CIS analysts, at the time of the battle, and analysts who view the history tape at a later time should be able to view a complete picture of the on-going battle.

Written Materials

There is a need to record automatically the information on all written documents associated with the operation. Currently, the written documents are collected and filed separately from the digital and communications tapes. This creates the possibility that critical data needed to analyze the operation, e.g., the documents which specify the commander's plans, orders, and intent, will not be available when required.

Recording written information in the computer database would ensure its availability and would probably also facilitate training. The system can currently retain data in the free-format message format but, ideally, documents should not have to be transcribed. A text scanner which is capable of accepting a hand-written or typed document and entering it into the system would be preferable. In addition, materials which are on a word processing system, e.g., Take Home Packages and scenarios, should be entered into the system in digital form.

Radio Transmissions

There is a need for the system to be able to record the voice radio and radio teletype communications which occur during the course of the operations. This provides the trainer and the analyst the capability of monitoring information flow in real-time, and of determining its effect on the outcome of the operation.

A recent analysis of the research potential of the 40-channel communication tapes found that the tapes are a rich source of detail and essential contextual information. The major problem with using the tapes is that it is, currently, a very labor intensive process considering that, with 40 communication channels, one rotation is the equivalent of 1280 days of recordings. In addition, there is a problem with override of channels. Electronic methods of processing the information would not be able to determine whether a transmission was a legitimate one or if it was coming through from another net (Avant, Kemper, & Henderson, 1986).

A parallel recording system for research purposes is also a necessity. Currently, when communication tape cuts are used for the After Action Reviews (AARs), recording is continued on a separate tape. This results in the requirement to switch back and forth between tapes when listening to them after a rotation.

Data Integration

The upgraded system must be capable of integrating the various NTC data sources so that effective analysis of an operation can be conducted after the actual training. To do so, there is a need for a time-tagging system which permits data stored on separate disks or tapes to be automatically synchronized for display. If one data source, i.e., the communication tapes, the digital tapes or the data base, is accessed, the other data sources must be able to be synchronized with it. This rapid access may involve, for example, digital recording of communications. Without this capability, excessively time-consuming and inefficient manual synchronization must be performed, which detracts from the analysis effort.

A strong candidate for integration of the data is the developmental SIMNET project (Appendix B). This project "has the potential to offer unique analytical capabilities . . . data recorded at the National Training Center could be transferred to the developmental SIMNET for both combat and training analysis."

It is critical that all of the data collected be stored in a functional, relational database. The capability of relating activities in one portion of the battlefield to activities in another, at any time, and in any sequence is essential to the analysis effort. The database also has to be flexible enough to answer questions from a variety of perspectives, e. g., by operating system or by echelon.

Specific Data Requirements

Format of Data Requirements

Data requirements are presented in this report in a format which generally relates them to the seven operating systems (Command and Control, Manuever, Fire Support, Intelligence, Air Defense, Mobility/Countermobility, and Combat Service Support) as defined in FM 71-2J, The Tank and Mechanized Infantry Battalion Task Force (December, 1984 Coordinating Draft). There are some discontinuities. Specifically, data requirements for the Fire Support operating system are included in the direct and indirect fire data requirements sections. Also, Mobility, Countermobility, and Survivability data requirements are addressed separately to improve specificity in the data requirements for each component. Twelve categories of data requirements are addressed.

Each category presents a list of general information needed to support analysis of the function. Specific data which are components of the general information categories are then provided. To provide a comprehensive data base, it is imperative that all data be collected for both BLUEFOR and OPFOR and that data be collected for all levels, including brigade/regiment.

After each data requirement, it is noted whether it is currently available, whether it will be available with the currently planned upgrade, or whether it is a future requirement. Those data requirements which require manual input are also noted. It is questionable if or when these data will be able to be collected unless they can be shown to have immediate benefit to the OCs training mission.

Command and Control

To support analysis of command and control functions, the system should be able to record information on the following:

- written orders, plans, and procedures;
- graphic control measures;
- verbal orders, concept statements, instructions, and discussions;
- concept of operations;
- conduct of the operation;

- decision cycle;
- firing effect data for all weapons system and units;
- mission analysis;
- intent and purpose two levels higher.

The data needed to support analysis of Command and Control activities are:

- position location of all vehicles and aircraft, all mounted and dismounted personnel, and all command and control installations (future);
- visual (map) display of all graphic control measures (upgrade);
- automatic, time-tagged entry into database of all written operations orders and fragmentary orders (FRAGOs) (future);
- audio recording of all radio transmissions made by unit leadership (current, upgrade will provide digital recording and time-tagging);
- audio/visual recording of backbriefs (future);
- subjective judgement of success/failure and strengths/weaknesses of operation by OCs (manual);
- kill data on selected vehicles and personnel (i.e., task force commander, executive officer [XO], Operations and Training Officer [S-3]; company/team commander, XO, first sergeant, etc.) to include time of kill, location (upgrade), and whether a vehicle or individual was resurrected and why (manual);
- visibility conditions including light, smoke, and fog (now: manual, future: instrumented);
- mission-oriented protection posture (MOPP) status of the task force (upgrade, when nuclear, biological, chemical [NBC] warfare have been employed; at other time, manual);
- visual display of all operations, intelligence, and fire support maps (future).

Communications

To support analysis of the effect of communication on operations, the system should be able to record information related to the following:

- written orders, plans, and procedures related to communication;
- actual voice radio and radio teletypewriter (RATT) communications;
- location and capability of radio transmitters;

- location and capability of radio jammers;
- net configuration data;
- wire communication systems;
- other communication methods.

The data needed to support analysis of communication activities are:

- position location of all vehicles equipped with a transmitter (future);
- type (future) and operational status (manual) of each transmitter on each vehicle equipped with a radio;
- number and length of transmissions (current for instrumented players);
- automatic entry into database of all written Communications-Electronics Operation Instructions (CEOIs), to include actual times of switching frequencies and length of time for everyone to be on correct net (future);
- capability of monitoring and recording secure and non-secure voice/RATT transmissions (future);
- automatic display of planning ranges for specific equipment, e.g., tactical operations center (TOC), command group, scouts, ground surveillance radar (GSR), and automatic analysis of the effect of terrain, weather, and time of day on transmission capability (future);
- all data tapes time-tagged to digital and database displays (upgrade);
- display of information on use/non-use of wire communication systems to include subjective analysis of the effectiveness of the system (manual);
- availability of materiel resources (e.g., commo wire) (manual);
- display of information on use/non-use of non-verbal communication (i.e., pyrotechnics, hand/arm signals) to include subjective analysis of the effectiveness of the system (manual);
- position location of all jamming assets (upgrade) and evaluation of the effectiveness of jamming (manual or future);
- start/stop time for each jammer (current).

Direct Fire

To support analysis of the effect of direct fire, the system should be able to record information related to the following:

- written orders, plans, and procedures related to the unit's direct fire plan;
- firing system identification (ID);
- target system ID;
- pairing of firing/target systems through killer code identification, not time pairings;
- graphic fire distribution and control measures;
- location of firing/target system in relation to X, Y, and Z axes;
- identification of whether firing/target system was moving or stationary;
- intelligence preparation of the battlefield (IPB) in relation to fire plan.

The data needed to support analysis of direct fire activities are:

- automatic entry into database of all written operations orders and FRAGOs (future);
- communication nets for all fire control directions (current);
- position location of all vehicles and personnel (future, although upgrade will significantly improve);
- type of weapons utilized in engagement (current, although there is a need to be able to separate tube-launched, optically-tracked, wire-guided missile systems [TOWs] employed in various ways);
- results of engagement, by individual weapon system (current; future: separation of catastrophic versus mobilization hits);
- range of engagement from engaging to engaged system (current);
- total rounds available and fired (current) with real time class V and all updates of resupply (upgrade);
- number of rounds fired to achieve kill (killed/killing system) (future);
- angle of engagement (+/- 5^{o}) of firing to target system and X, Y, and Z coordinate orientation for all vehicles to include turret orientation for all vehicles so equipped (future);

- detection, target prioritization procedures (upgrade);

- improved resolution of terrain data for visual display (1:25,000 or 1:12,500 with 3X enlargement) or contour interval resolution to one meter (future);

- varying symbol size (upgrade);

- visibility conditions including light, smoke and fog (current: manual; future: instrumented);

- visual (map) display and automatic entry into database of all graphic fire control measures (platoon through brigade) (upgrade);

- speed of movement of engaging and engaged system/unit (future);

- benign realism of simulation (future);

- amount of target exposure at time of engagement (expressed in terms of fully exposed, hull defilade, turret defilade, full defilade) (future).

Indirect Fire

The participants stated that more effective field simulation of the effect of impacting artillery was necessary. To support analysis of the effect of indirect fire, the system should be able to record information related to the following:

- written orders and instructions related to the fire support plan;

- detection and target prioritization decisions;

- graphic control measures and target location;

- verbal orders, instructions, and discussion;

- location of firing system;

- time of system firing;

- location and time of impact of delivered rounds;

- assessment of effect of delivered rounds;

- status of artillery class V;

- effects of counterfire;

- utilization of NBC weapons.

The data needed to support analysis of the activities listed above are:

- position location of all cannon and mortars (upgrade);
- position location of all support vehicles (current, if instrumented);
- position location of all personnel (firing battery and support) (current, if instrumented);
- types and number of rounds fired (current: tactical fire direction system [TACFIRE]; upgrade will improve);
- visual (map) display of all graphic control measures (upgrade);
- automatic entry into database of all written operation orders and FRAGOs (future);
- communication tapes of all fire support radio nets (current, if prioritized);
- recording of all TACFIRE data bases (upgrade);
- automatic entry into database of all manually-calculated firing data (current: post operation);
- visual (map) display of location and distribution of impact of rounds and data display of time and effect of mission (upgrade);
- automatic battle damage assessment against specific vehicles and personnel affected by the impact of rounds (upgrade) and flexibility to incorporate simulated area weapons effects - radio frequency (SAWE-RF) in early 1990's (future);
- automatic update of artillery class V ammunition status based on rounds expended and resupplied (current, if in TACFIRE);
- visual (map) display of location and density of all family of scatterable mines (FASCAM) minefields (TACFIRE upgrade);
- visibility conditions including light, smoke, and fog (current: manual; future: instrumentation);
- real time linkage of casualty assessment to firing event (current TACFIRE capability there, but needs to be refined);
- time linkage of firing event to appropriate control measures (current; will be improved in upgrade);
- time of employment of NBC weapons, type of weapon, and effects (upgrade);
- benign realism of simulation (future).

Maneuver

In order to analyze the effect of maneuver on operations, the system must be capable of recording information on the following:

- written orders, FRAGOs, and plans relating to maneuver;
- division commander's intent for maneuver;
- location of all combat, combat support, and combat service support forces;
- NBC conditions;
- graphic control measures.

The data needed to support this analysis are:

- position location of all personnel and vehicles (future);
- position location of all command and control facilities (upgrade);
- changes in rate of movement (of units and weapons systems on both sides when BLUEFOR is firing) linked to the number of weapons firing (future);
- visual display of all graphic control measures (upgrade);
- rate of movement for all personnel and vehicles and as units (platoon, company, battalion) (future);
- automatic entry into database of all written orders, plans, and FRAGOs (future);
- audio tapes of all radio transmissions on the task force through platoon command nets (current, if given priority);
- time of NBC employment, type of NBC weapon, and effects (upgrade);
- visibility conditions including light, smoke, and fog (current: manual; future: instrumented);
- information on whether infantry personnel are mounted or dismounted (current: manual; future: instrumented).

Mobility

In order to analyze the effect of mobility on operations, the system must be capable of recording information on the following:

- written orders, plans, and procedures related to mobility operations;
- trafficability;

- mobility operations;

- specific locations, configuration, and quality of enemy obstacles.

The data needed to support analysis of mobility functions are:

- position location of all planned and executed obstacles (man-made [future] and natural [current, but requires refinement]) and data on obstacle configuration to include X, Y, and Z coordinates (current: manual; future: instrumented);

- density of materiel (mines, wire, pickets, and other items) in obstacle (mines: upgrade; other: manual);

- intelligence data collected on enemy obstacles to include position location, configuration in the X, Y, and Z coordinates, density of mines, wire, pickets, and other construction materiels, time of report, reporting agency, and action taken on report (future);

- position location of all breaching vehicles and resources (upgrade, if given priority);

- automatic entry into database of all mobility related orders, plans, procedures, and statements of intent (future);

- exact location of breach to include X, Y, and Z coordinates (current);

- time to accomplish initial and all subsequent breaches (current);

- total number of breaches attempted (manual) and completed (current);

- automatic entry into database of all written operations orders and FRAGOs dealing with mobility operations (future);

- communication tapes related to mobility operations (current, if given priority);

- visual display of all graphics associated with mobility operations (upgrade; trafficability analysis: future);

- total number of personnel, number of vehicles, special resources to breach, and time losses (current);

- total work and travel time (current);

- total idle time (current);

- location and status of planned lanes through obstacles (current, with communication tapes);

- effectiveness of smoke (manual);

- effectiveness of suppression (manual).

Countermobility

To support analysis of the effect of countermobility on operations, the system should be able to record information related to the following:

- written orders, plans, and procedures related to countermobility;
- specific location, configuration, and quality of friendly obstacles;
- obstacle effect;
- integration of the obstacle into the fire plan/security plan of the unit.

The data needed to be collected to support analysis of these activities are:

- type, position location, and configuration of all obstacles in the X, Y, and Z coordinates (natural: current, but requires refinement; man-made: manual);
- quantity of resources used in obstacle construction:
  - mines
  - wire
  - pickets
  - blade hours
  - rounds (FASCAM)
  - manhours
  - other construction materials (logs, concrete, sandbags, etc.) (manual);
- sources of resources and how transported (manual);
- time estimated for construction (manual);
- automatic entry into database of all written orders, plans, FRAGOs, and standing operating procedures (SOPs) related to countermobility operations (future);
- automatic entry into database of commander's intent (manual, through free format message);
- automatic entry into database of unit fire plan in relation to obstacle (graphic and written data) (current: manual; upgrade: TACFIRE);
- total work time plus travel time (current);

- total idle time (manual);

- location (current) and status (manual) of planned lanes through obstacles;

- display of resources available for obstacle construction in brigade support area (BSA), amount requested by unit, amount transported forward, and amount used (manual);

- tapes of voice radio (current, if given priority)/RATT transmissions (future) related to countermobility operations;

- firing data related to emplacement of FASCAM obstacles to include rounds available (current), time required for delivery (TACFIRE upgrade), and density (upgrade: FASCAM; future: other) of the minefields.

Survivability

In order to analyze the effect of survivability, the system must be capable of recording information on:

- written orders, plans, and procedures related to survivability;

- quality of construction;

- time of emplacement;

- resources consumed.

The data needed to support analysis of survivability functions are:

- position location of all survivability positions (manual);

- position configuration to include X, Y, and Z axes (manual);

- amount and type of overhead cover (manual);

- type of position (fighting vehicle, command and control, combat service support [CSS]) (manual);

- amount of resources available for construction (i.e., sandbags, wood, pickets, wire, blade hours) (manual);

- amount of resources used in construction (manual);

- time taken to emplace resources (manual);

- total work and travel time (manual);

- total idle time (manual);

- degree of defilade of protected items (manual);

- automatic entry into database of all written orders, plans, FRAGOs, and SOPs relating to survivability operations (future);

- quality of completed positions (manual);

- frequency and time survivability positions are utilized (manual);

- visual display of all graphics associated with survivability positions (manual).

Intelligence

In order to analyze the effect of the intelligence function on operations, the system must be capable of collecting information on the following:

- written orders, plans, and procedures related to intelligence activities;

- staff actions relating to Intelligence Preparation of the Battlefield;

- status of intelligence gathering assets;

- reconnaissance and surveillance plans.

The data needed to support analysis of intelligence activities are:

- position location of all intelligence gathering assets (upgrade, if given priority);

- actual position location of all intelligence targets (current, needs graphic symbol);

- position location of intelligence targets based on the result of unit collection plans (not necessarily actual) (manual);

- graphic control measures related to collection plans (named areas of interest [NAI], target areas of interest [TAI], screen lines, etc.) (upgrade);

- automatic entry into database of intelligence estimate at exercise start, updated through end of exercise (manual);

- location and operational status of night vision devices (manual);

- operational status of GSRs (manual);

- automatic entry into database of deception techniques (manual);

- accuracy of spot reports from company teams (manual);

- reported enemy kills versus actual kills (future);

- fratricide of intelligence eletronic warfare (IEW) assets (current, if instrumented);

- cycle time for intelligence information for each intelligence asset (manual);

- communication tapes related to intelligence activities (current).

Air Defense Artillery

In order to analyze the effect of air defense artillery (ADA) on operations, the system must be capable of recording information on:

- written orders, plans, and procedures related to ADA;

- weapon availability and capability;

- target ID;

- engagement resolution.

The data needed to support analysis of Air Defense Artillery functions are:

- position location of all ADA weapon systems and support vehicles (upgrade, if instrumented);

- automatic entry into database of all written operations orders, and FRAGOs related to ADA (future);

- audio recording of ADA early warning net (current, if given priority);

- position location of all Army and Air Force aviation assets on the X, Y, and Z coordinates (future);

- recording of identification of friend or foe (IFF) data (future);

- pairings between air and ground weapon systems (future);

- use of IPB for every air avenue of approach (manual);

- ADA weapon status and ammunition available and fired (current);

- audio recording of ADA platoon/battery radio command net (current, if given priority).

Combat Service Support

A separate system which would allow Combat Service Support to be examined would be an advantage. To support analysis of the effect of combat service support, the system should be able to record information relating to the following activities:

- written plans, orders, and procedures related to combat service support operations;
- location of logistic installations;
- quantity and location of specific classes of supply;
- graphic control measures;
- locations of key leaders;
- location and rate of movement of all logistic vehicles to include helicopters;
- availability of logistic support vehicles.

The data needed to support analysis of Combat Service Support activities are:

- position location of all vehicles and personnel (upgrade, if instrumented);
- position location of all support installations (X, Y, and Z coordinates) (current);
- type and capacity of all support installations and actual availability to include resources stored and loaded on vehicles (future);
- time, quantity, method, and source of resupply (manual);
- total hours of operation of each equipment per day, by weapon system (and subsystem, where applicable) (future);
- automatic entry into database of all written operations orders, FRAGOs, and requests dealing with logistics (future);
- kill data on support vehicles (current, if instrumented);
- visual display of all graphic control measures related to CSS (current);
- operational readiness status of selected support vehicles, i.e., Not Mission Capable-Maintenance (NMCM) or Not Mission Capable-Supply (NMCS);
- tracking of all decontamination activities and sites (current);

- total of all large caliber rounds fired per day by weapons system type (current);

- repair state of damaged or inoperative vehicles (play and actual) (manual);

- status and strength of force at beginning of exercise (current) and after reconstitution (personnel and equipment) (manual) with real-time updates;

- audio recording of all voice communication on logistic nets (current, if given priority);

- automatic entry into database of all RATT logistic traffic (future);

- status of all casualties, location of casualty in evacuation process, nature of wound, nature of treatment, and time of entire treatment process (regardless of severity) (manual);

- location of all medical units, medical and evacuation vehicles, casualty collection points and transfer points, and other medical assets (future);

- indication of who performed initial treatment (medic, trained combat lifesaver, other) (manual);

- adequacy and appropriateness of initial treatment (manual);

- time between wounding and arrival of medic (future);

- method of evacuation (manual);

- kill data on medics and medical vehicles (current, if given priority);

- status of medical supply (manual);

- displacement time for battalion aid station (manual);

- number of casualties assessed in each triage category (manual);

- number of casualties in IMMEDIATE triage category "lost" because of delay in obtaining treatment (manual);

- number of casualties "lost" due to improper treatment (manual);

- expenditure or consumption rate by unit by mission of specific classes of supply (manual);

- real-time tracking of logistic resupply movements (current, if given priority);

- mission oriented protection posture (MOPP) status of the support units (manual);

- time of NBC employment, type of NBC weapon, and effects (current);

- security measures planned and in place at support installations (manual).

Miscellaneous

There are additional areas of interest which are outside the operating system structure. In order to determine their effects, the system must be capable of recording information on:

- environmental conditions;

- administrative information.

The data needed to support these areas are:

- real-time data on weather to include temperature, humidity, wind speed and direction, inversion layer changes, precipitation, and dew point (current: manual; future: instrumented);

- visibility data including light and smoke conditions (current: manual; future: instrumented);

- effects of bispectral smoke/dust and smoke operations on weapon acquisition and fire control equipment (future);

- soil conditions (future);

- capability of updating task organization changes (upgrade);

- start and end times of engagements (manual);

- hours previously worked without break and/or sleep (manual);

- time tags for units going into/staying in MOPP I, II, III, IV (future);

- reasons for OC kills (i.e., indirect fire, minefields, NBC, Air Force tactical air (TACAIR), subjective judgement) and resurrections (current: manual; future: instrumented).

Conclusions

The instrumentation system is capable of directly providing player and weapon identification; position location information, by time; and firing, communication keying, and engagement result data, by time. The planned upgrade will increase the capacity of the system and provide better player identification and pairing data. Additional software modifications would allow many of the above data requirements to be met. However, other

requirements will require additional technology. For example, through-sight video and the development and acquisition of additional, improved, smaller B-units have the potential for improving data collection. Another technological improvement would be to have a "Dial-A-Kill" on the controller guns so that the reasons for the kills assessed by the OCs are automatically captured.

There is also a requirement for improving simulation, particularly for indirect fire, at the NTC. While this is certainly the most realistic training environment ever developed, to the extent that simulation is unrealistic, it impacts both on training and on the interpretation of data for Lessons Learned.

If technology is available, an automatic method of determining degree of defilade for vehicles would be of great value. NTC Operations Group personnel would also like a system which provides data for platoon and company After Action Reviews (AARs) which is comparable to that provided for the task force. Of highest priority to them would be the ability to obtain still photographs of platoon and company positions relative to the OPFOR within one hour after a mission is completed. They would also like to have a replay stations in the AAR vans to be able to graphically show the battle.

A major innovation which would support many of the data requirements is an electronic clipboard. The OCs at the NTC currently work extremely hard. Their primary mission is clearly training and additional requirements cannot be placed on them without supplying additional resources. In the course of conducting their training, they must make observations and notes regarding critical events and unit performance to provide feedback to the units. Currently, this is done using paper and pencil. Technology, such as an electronic clipboard, must be developed to assist them in doing their jobs more efficiently and to provide improved information for AARs and Take Home Packages. This technology would have the additional advantage of standardizing observations and, thus, increasing their value for Lessons Learned.

ARI has developed one prototype of an electronic clipboard (see Appendix C). It would allow for downloading of performance observation guides into a hand-held clipboard. Specific observation guides might be downloaded, depending on the OC function, or appropriate observation guides could be easily accessed. Data on performance would be input into the clipboard by the OCs in the field. The digital data in the clipboard could then be radioed to the CIS or uploaded through an RS232 connector directly into the CIS.

In addition to these basic functions, personnel from the NTC Operations Group indicated that a built-in tape recorder in which comments were time-tagged would improve the utility of the clipboard. They would also like the clipboard system to analyze the input data and provide timely feedback for AARs. Another useful feature would be to have the CIS, through the clipboard, signal the OCs regarding specific events, e.g., the impact of artillery rounds or when the OPFOR entered a named area of interest. It is important that current software modifications are flexible enough to support such requirements.

The NTC has been extremely successful in meeting its training goals. Units have been exposed to the most realistic, intense training environment ever developed. The Chief of Staff's NTC Policy Statement in September, 1984,

emphasized the need to continue this tough, successful training while finding ways to expand the NTC's capabilities to promote innovation. One way to meet this challenge, he stated, was to "develop the NTC range instrumentation and associated long-range plans to permit detailed analysis and feedback. . . . We must all work together to harness the NTC's full potential and spread the NTC experience throughout the total Army." It is the goal of this report to facilitate discussion to ensure this mission is accomplished.

References

Avant, R., Kemper, T. R., & Henderson, B. (1986, April). An Evaluation of the Acoustic Quality and Research Potential of Communications Recordings from the National Training Center (BDM/ARI-TR-0013-86). Monterey, CA: The BDM Corporation.

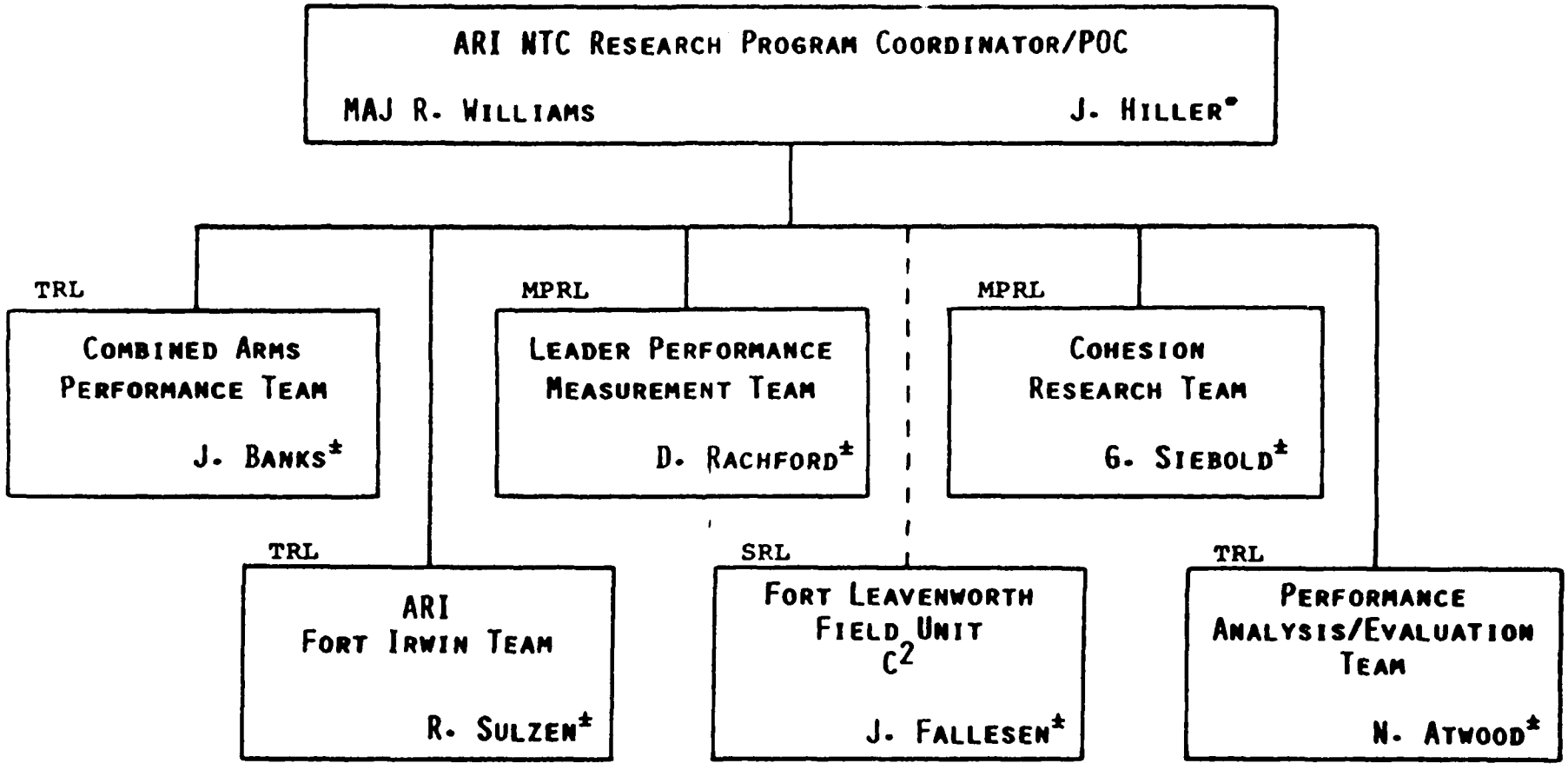
Johnson, C. (1986, June). National Training Center Lessons Learned: Data Requirements (ARI Research Note 87-15). Presidio of Monterey, CA: U.S. Army Research Institute Field Unit. (AD A181 097)

APPENDIX A

ARI NTC-BASED RESEARCH

PROGRAM OVERVIEW

ARI ORGANIZATION



MPRL = Manpower & Personnel Research Lab
SRL = Systems Research Lab
TRL = Training Research Lab

• Program Manager
± Principal Investigator

ARI RESOURCES FOR NTC-RELATED RESEARCH

- In-House Personnel: 19 Professional Staff Years

- Contracts:
  - $2.1 Million/Year +
  - Projected for 7 Years

- Computer System:
  - $1.4 Million for Procurement, Plus Maintenance
  - VAX 11/780 with 1366 MB Memory
  - 2 NTC Work Stations
  - 30 Terminals
  - Statistical and Database Software

TASK AREAS IN CATA/ARI LOA ON NTC

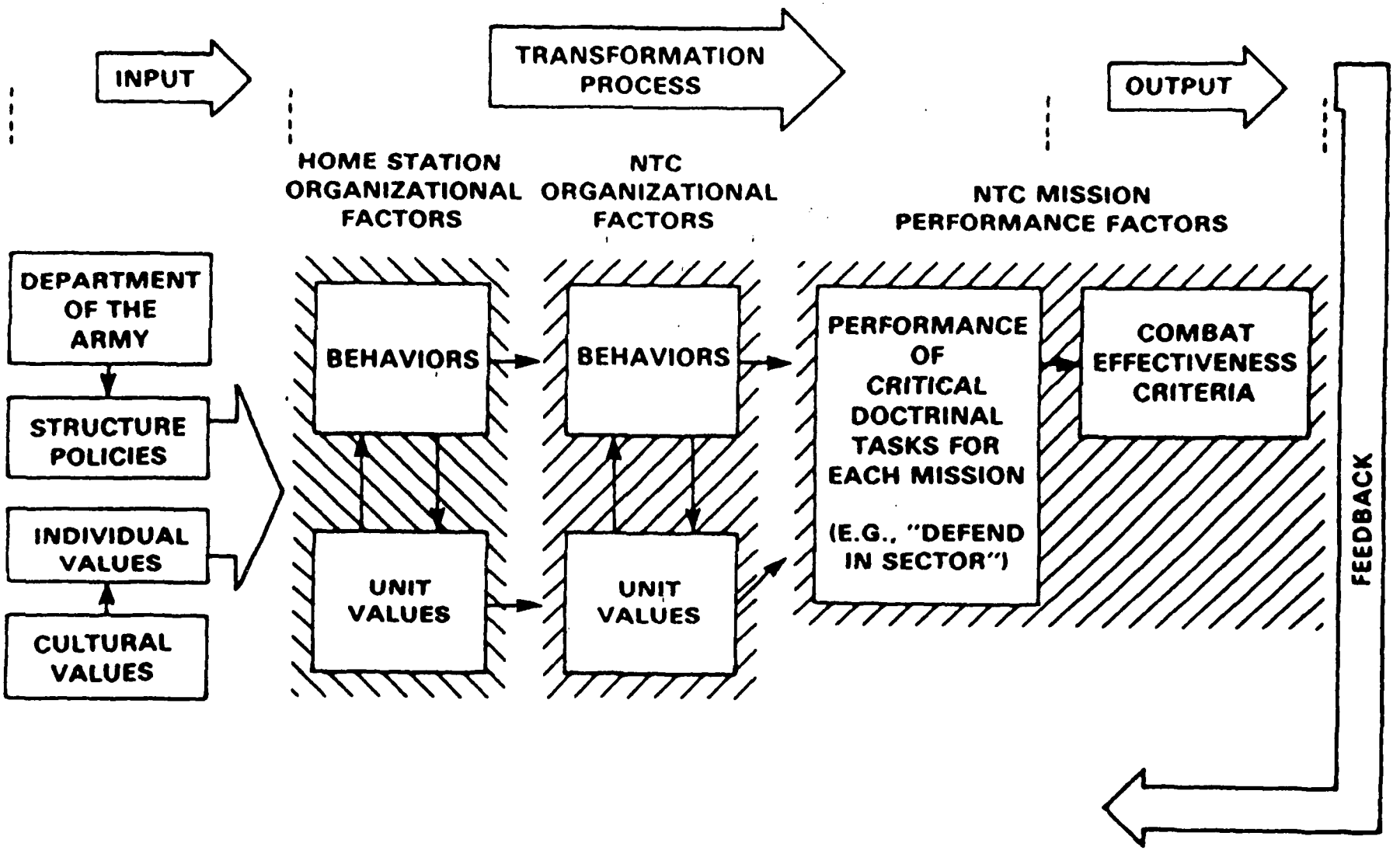
- METHODS FOR USE OF NTC FINDINGS IN DOCTRINE, ORGANIZATION, EQUIPMENT, AND TRAINING DEVELOPMENT

- LEADERSHIP AND COMMAND, CONTROL, INTELLIGENCE (C^2I)

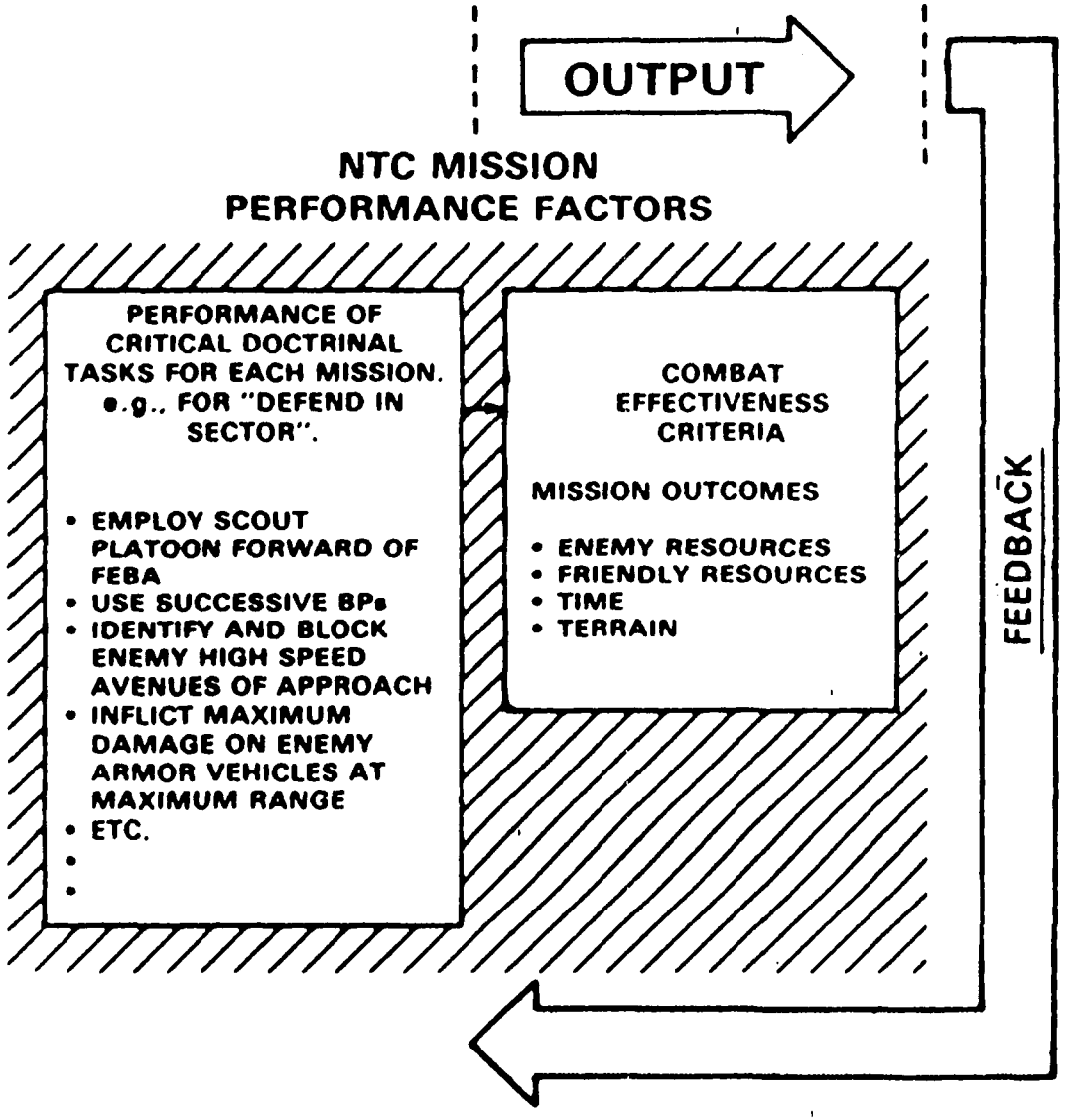
- METHODS FOR BETTER INTEGRATION OF NTC TRAINING WITH HOME STATION TRAINING

- METHODS TO IMPROVE UTILITY AND QUALITY OF NTC DATA

UNIT COMBAT EFFECTIVENESS MODEL (UCEM)



A. DEVELOP SYSTEM FOR MEASURING EFFECTIVENESS OF UNIT PERFORMANCE

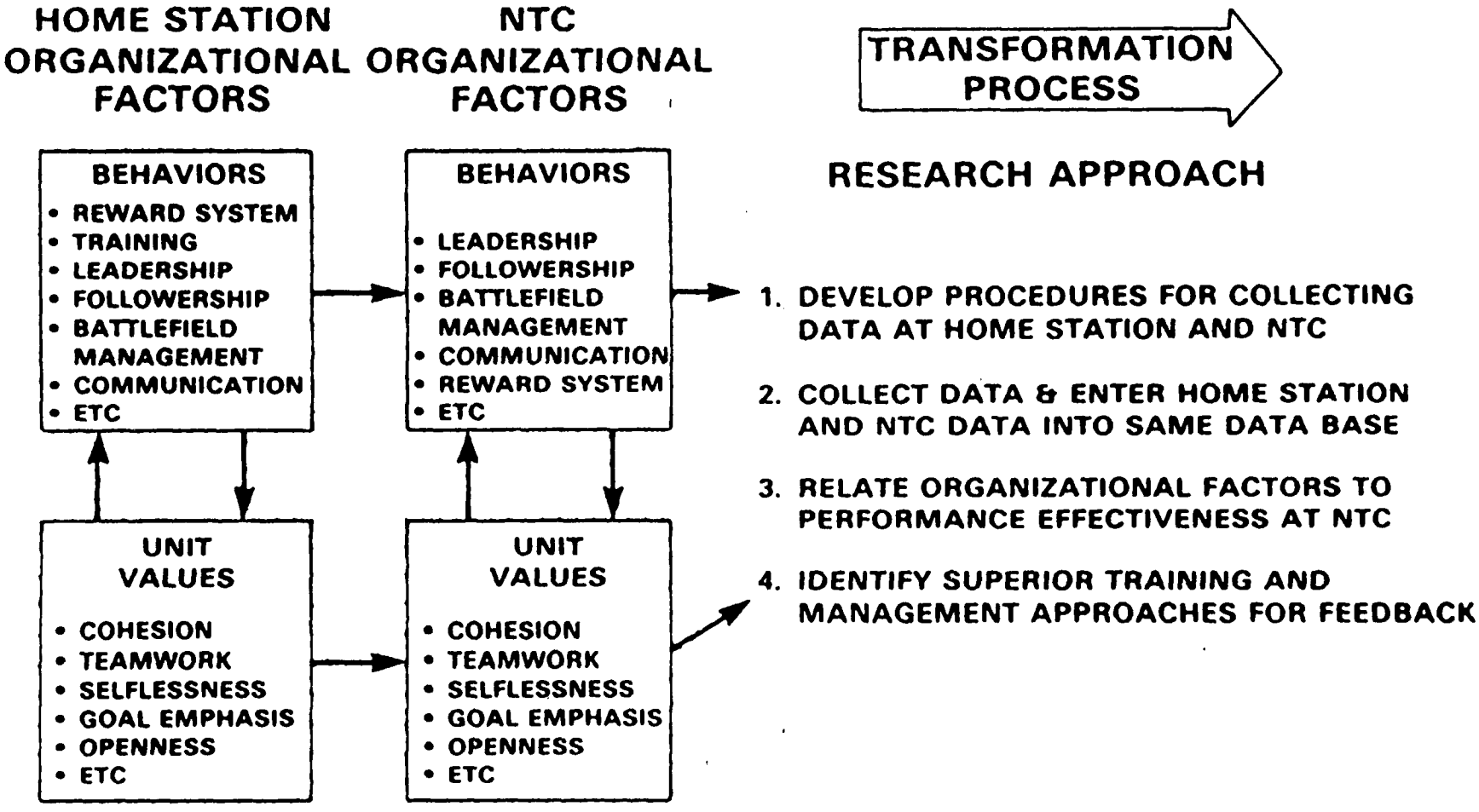


RESEARCH APPROACH

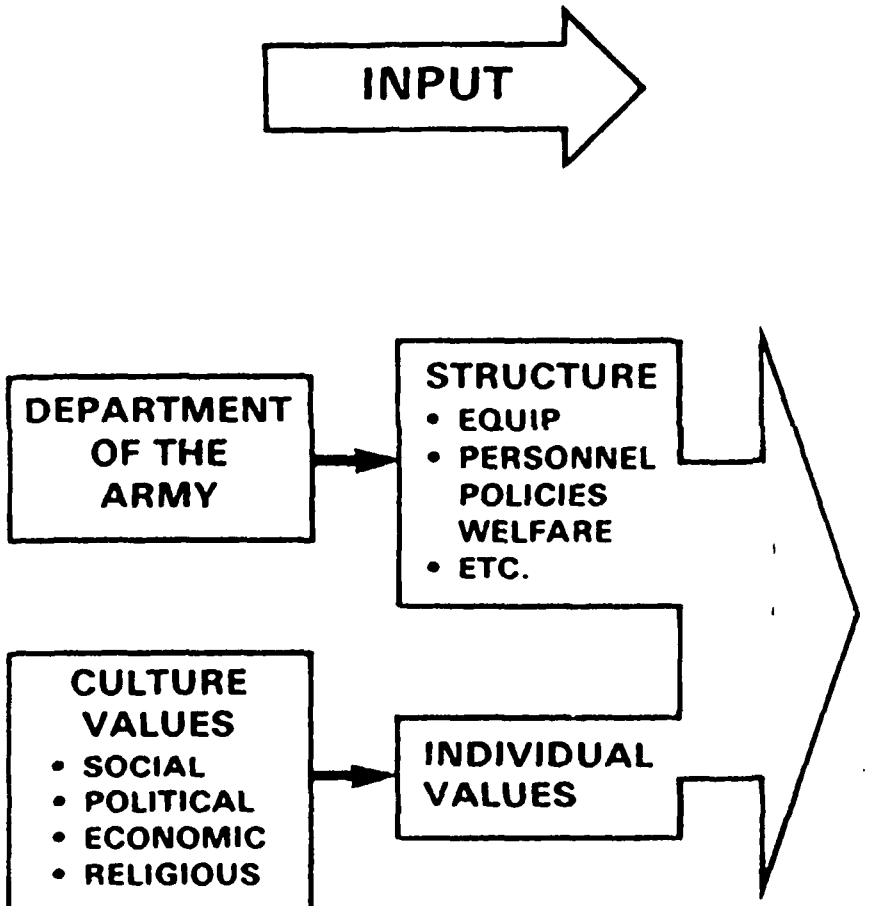
- DEVELOP FOR NTC MISSIONS AND CONDITIONS
  - MISSION PERFORMANCE STANDARDS AND MEASURES
  - CRITICAL TASK & MEASURES FOR UNITS AND LEADERS
  - ELECTRONIC CLIPBOARD FOR DATA COLLECTION
- HAND OFF MEASUREMENT METHODOLOGY
  - AMTEP STANDARDS SET BY UNITS FOR THEIR OWN CONDITIONS
  - ELECTRONIC CLIPBOARD FOR HOME STATION USE

B. DEVELOP LESSONS LEARNED METHODOLOGIES FOR:

- TRAINING
- LEADERSHIP
- COHESION
- INDIVIDUAL SOLDIER



C. PRODUCE INFORMATION FOR POLICY DEVELOPMENT



RESEARCH APPROACH

- INFORMATION FOR
  - RECRUITMENT
  - SELECTION/CLASSIFICATION
  - ASSIGNMENT
  - TRAINING
  - READINESS
  - RESOURCING

PRODUCTS ALREADY GIVEN TO CATA

- LESSONS LEARNED PRODUCTS
  - Lessons from the NTC
  - Lessons from the NTC: Common Battalion Task Force Training Needs
  - Comparison of the BFVS and M113 Equipped Battalion Task Forces on Live Fire Performance at the NTC
  - A Survey Comparing the M2/3 Bradley Fighting Vehicle and the M113 Armored Personnel Carrier by Members of the NTC Operations Group and OPFOR
  - "What Now, Captain?" - Concept for Using NTC Data and Displays in Tactical Instruction
  - NTC Leadership Lessons Learned

- PRODUCTS SUPPORTING OPERATIONS GROUP
  - NTC Instrumentation System Initialization Procedure
  - The DeAnza Primer

- PRODUCTS TO IMPROVE UTILITY OF NTC DATA
  - Data Requirements
  - NTC Data Library Procedures
  - Status Report on ARI Capability to Analyze NTC Instrumented Data
  - Analysis of commo tapes
  - Analysis of AAR videotapes

CURRENT RESEARCH ACTIVITIES

- Data Archive at ARI-POM
- Analyses of Existing Data
- Requirements for Improving Quality and Utility of Data
- NCO Focused Rotation
- Development of NTC Performance Measurement System
- Support of NTC Operations Group
- Additional Contracts:
  - Home Station Determinants of NTC Performance
  - Incorporation of Human Issues in Combat Process Model

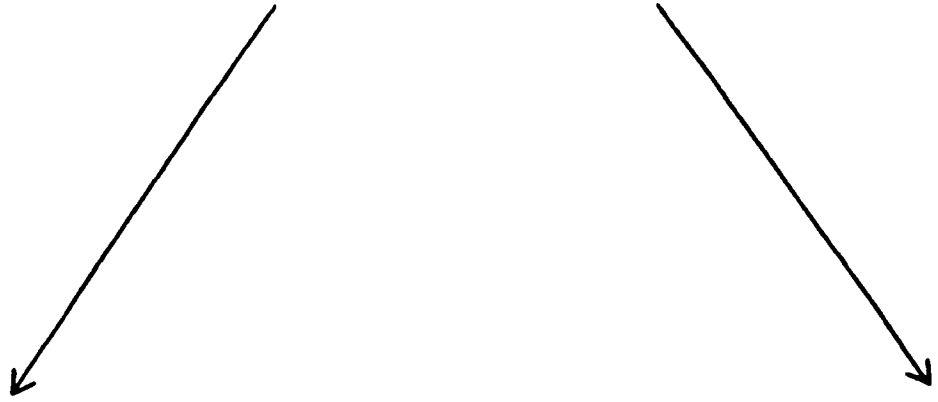
INITIAL WORKING GROUP MEETING

TO IMPROVE QUALITY AND UTILITY

OF NTC DATA FOR LESSONS LEARNED

13-14 May 1986

IMPROVING DATA QUALITY



LESSONS LEARNED

IMPROVE TRAINING

INITIAL WORKING GROUP MEETING

- PURPOSES:
  - SHARE INFO
  - DEVELOP RECOMMENDATIONS TO IMPROVE NTC DATA FOR LESSONS LEARNED

- PARTICIPANTS:
  - ARI
  - CATA
  - TRAC
  - AMEX CORP.
  - ARROYO CENTER
  - ATSC
  - ATB
  - CDEC
  - USAIC
  - THE BDM CORP.

LESSONS LEARNED USERS

- CATA
- RESEARCH (ARI, ARROYO CENTER)
- MODELING AND GAMING (TRAC)
- SCHOOLS
- BATTLE SIMULATIONS
- DA
- FORSCOM
- AMCOM
- TRADOC

MAJOR LESSONS LEARNED DATA SOURCES

- Instrumentation System

- Communication Tapes

- Take Home Packages (THPs)

- NO SINGLE DATA SOURCE IS COMPLETE.

- MUST INTEGRATE TO GET TRUE PICTURE.

- INTEGRATION OF DATA SOURCES IS DIFFICULT AND LABOR-INTENSIVE.

LESSONS LEARNED ISSUES

- INSTRUMENTATION SYSTEM
  - MISSING MANUALLY-ENTERED DATA
  - 500 PLAYER LIMITATION (400-425 ACTUAL)
  - COVERAGE PROBLEMS / TERRAIN MASKING
  - ELECTRONIC HARDWARE PROBLEMS LEADING TO SPURIOUS, INACCURATE, DUPLICATION OF EVENTS
  - MILES LIMITATIONS (SMOKE, ETC.)
  - POOR KILLER/VICTIM INFO
    - -- LOTS OF SHOOTING AND FEW HITS
    - -- MANY KILLS WITH NO IDENTIFIED SHOOTER

LESSONS LEARNED ISSUES (CONTINUED)

- COMMO TAPES
  - RICH DATA SOURCE
  - LABOR-INTENSIVE
  - CHANNEL OVERRIDE
  - NEED SECOND RECORDING SYSTEM TO COMPRESS TAPES

- TAKE HOME PACKAGES
  - STANDARDIZATON OF OBSERVATIONS ESSENTIAL
  - HARD TO TIE TO ARTEP

RECURRING THEMES

- OCs/CIS ANALYSTS ARE EXTREMELY BUSY.
- ADDITIONAL REQUIREMENTS CANNOT BE GENERATED WITHOUT ADDITIONAL RESOURCES.
- LESSONS LEARNED REQUIREMENTS NEED TO BE INTEGRATED INTO ON-GOING TRAINING REQUIREMENTS.
- NEED TOOLS TO ASSIST OCs TO "WORK SMARTER, NOT HARDER."

LESSONS LEARNED REQUIREMENTS

- HARDWARE:
  - GOOD KILLER/VICTIM DATA IS A "MUST-HAVE"
  - ELECTRONIC CLIPBOARD
  - ADDITIONAL B-UNITS
- SOFTWARE:
  - SYSTEM UPGRADE
- PROCEDURAL:
  - NEED CONSISTENT OBSERVATIONS AMONG OCS
  - DEVELOPMENT OF OBSERVATION GUIDES

NEAR-TERM WORKING GROUP RECOMMENDATIONS

- OBTAIN INFO ON CURRENT NTC PROCEDURES
- DETERMINE WHAT UNITS NEED IN ORDER TO INTEGRATE TRAINING AND LESSONS LEARNED
- RETAIN COMMO TAPES
- OBTAIN ADDITIONAL INFO (OPORDs, GRAPHICS)
- USE FREE-FORMAT CAPABILITY FOR:
  - NUMBER OF FRIENDLY/ENEMY KILLS, BY WEAPON SYSTEM
  - FRAGOs
  - SMOKE/WEATHER CONDITIONS
  - START/END TIME OF BATTLE
  - REASON FOR OC KILL/RESURRECTION
- ENTER COMPLETE HEADER DATA FOR EACH MISSION

APPENDIX B

ARMOR SCHOOL LETTER ON SIMNET

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY ARMOR SCHOOL
FORT KNOX, KENTUCKY 40121-5215

Office of the Director
Directorate of Combat Developments

Major T. Kenney
Combined Arms Training Activity
ATTN: ATZL-TAL-N
Fort Leavenworth, Kansas 66027

References:

a. Letter, Headquarters, U.S. Army Combined Arms Center, ATZL-TAL, undated, subject: Training and Lessons Learned Data Requirements from the National Training Center (NTC).

b. Meeting between Lieutenant Colonel Buckley, U.S. Army Armor School, Directorate of Combat Developments and Lieutenant Colonel Coon, U.S. Army Combined Arms Training Activity, 11 September 86, subject: Training and Lessons Learned Data Requirements from the National Training Center (NTC).

The Directorate of Combat Developments, Fort Knox, Kentucky provides the following comment on the draft data requirements document for National Training Center:

Although the document outlines most of the data collection requirements relevant to combat developments (CD), the concept of data integration (page 4, reference a.) is not sufficiently explained. As outlined in reference b, the developmental SIMNET project has the potential to offer unique analytical capabilities to the CD community and should be considered a primary candidate for National Training Center data integration. The concept is that data recorded at the National Training Center could be transferred to the developmental SIMNET for both combat and training analysis. SIMNET-D could then send substantive results to the National Training Center, Combined Arms Training Activity, or (in the case where current modeling algorithms may be changed) to the CD community. In this regard, it is recommended that:

(1) The statement of work to the National Training Center instrumentation upgrade contractor specify the requirement for data integration with developmental SIMNET.

(2) An National Training Center instrumentation contractor representative meet with a technical representative from Bolt, Beranek and Newman, to discuss technical requirements to facilitate interface. The Fort Knox, Directorate of Combat Developments, AirLand Battle Test Bed will coordinate this meeting, if desired by Combined Army Training Activity.

Point of contact at Fort Knox, Directorate of Combat Developments is Lieutenant Colonel John Buckley, autovon 464-2658/5764.

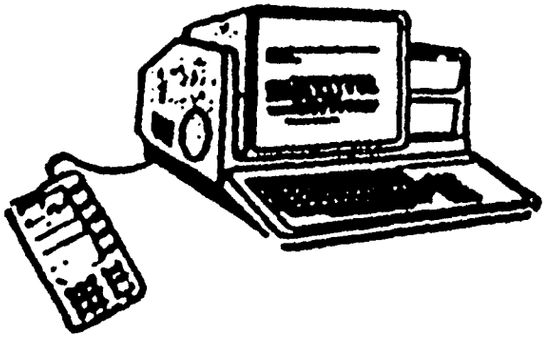
Sincerely,

for Donald L. Smart
Colonel, Armor
Director

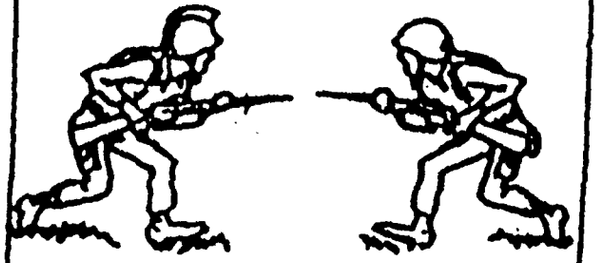
APPENDIX C

ELECTRONIC CLIPBOARD

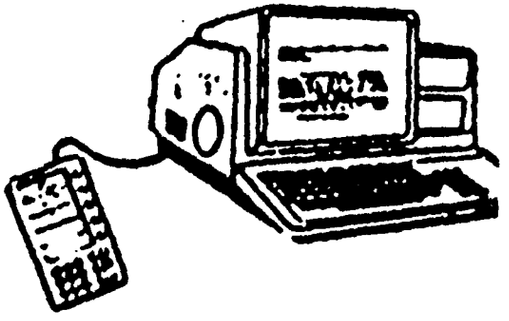
ELECTRONIC CLIPBOARD



SELECTIVE CHECKLIST LOADING FROM DATA BASE (ARTEP, DRILL, SM)



CHECKLIST AIDED PERFORMANCE EVALUATION AND DATA INPUT



AFTER EVALUATION, AUTOMATED DATA INPUT TO UNIT/SOLDIER TRAINING DATA BAS

ELECTRONIC CLIPBOARD: HARDWARE FEATURES

- COMPATIBLE WITH IBM-PC XT AS BASE STATION COMPUTER
- BLACK AND WHITE TEXT DISPLAY
- TOUCH SENSITIVE SCREEN
- REAR ILLUMINATED FOR NIGHTTIME USE
- POWERED BY RECHARGEABLE BATTERIES SUPPORTING:
  - -- 8 HOURS OF USE WITHIN AN 80 HOUR PERIOD (DAY USE)
  - -- 4 HOURS OF USE WITHIN AN 80 HOUR PERIOD (NIGHT USE)
- RECHARGING THROUGH ATTACHMENT TO BASE-STATION COMPUTER OR USING FIELD CHARGERS
- SIZE: 7.55" (HEIGHT) X 11.50" (WIDTH) X 1.88" (THICKNESS)
- WEIGHT: 4.5 LBS

ELECTRONIC CLIPBOARD: PRIMARY SOFTWARE FUNCTIONS

- IDENTIFY THE EVALUATOR
- IDENTIFY THE STUDENT (UNIT)
- IDENTIFY A DRILL*
- TRAIN ON A DRILL
- EVALUATE A DRILL
- REVIEW PASS (1, 2, OR 3)

*"DRILL" IS GENERIC TERM FOR ANY TRAINING/EVALUATION TEXT

ELECTRONIC CLIPBOARD

FIELD TEST

- TRY-OUT AT ARMOR SCHOOL, FT KNOX, IN NOVEMBER 1985
- USED FOR EVALUATION OF INDIVIDUAL SKILLS
- MAJOR OUTCOMES:
  - -- STRONG USER SUPPORT AND ACCEPTANCE
  - -- NEEDS FOR IMPROVEMENT:
    - LOW CONTRAST OF SCREEN DISPLAY
    - OCCASIONAL UNRELIABILITY OF TOUCH PAD
    - INCREASED SCROLLING RATE

ELECTRONIC CLIPBOARD:

PLANS FOR SECOND GENERATION PROTOTYPE

- IMPROVED CONTRAST OF SCREEN DISPLAY
- INCREASED RELIABILITY OF TOUCH PAD
- RUGGED HARDENED CASE TO WITHSTAND:
  - -- DROPPING
  - -- EXTREME TEMPERATURES
  - -- EXCESSIVE MOISTURE
- COMPATIBILITY WITH ITMS HARDWARE
- POTENTIAL LASHING TO JEEP DASHBOARD WITH ATTACHMENT TO JEEP POWER SOURCE